

### PRELIMINARY CONCEPTS

1.- Consider the following isoelectronic species: Ar, K<sup>+</sup>, Ca<sup>2+</sup>, Cl<sup>-</sup> and S<sup>2-</sup>. Which one is the smallest? And the biggest? And the one with highest charge density?

<input type="checkbox"/>	Ca <sup>2+</sup> is the smallest, S <sup>2-</sup> is the biggest and Ca <sup>2+</sup> has the highest charge density
<input type="checkbox"/>	S <sup>2-</sup> is the smallest, Ca <sup>2+</sup> is the biggest and S <sup>2-</sup> has the highest charge density
<input type="checkbox"/>	K <sup>+</sup> is the smallest, Cl <sup>-</sup> is the biggest and Ar has the highest charge density
<input type="checkbox"/>	S <sup>2-</sup> is the smallest, Ca <sup>2+</sup> is the biggest and S <sup>2-</sup> has the highest charge density

2.- Which of the following statements is false?

<input type="checkbox"/>	Only three quantum numbers are needed to define the orbital of an electron (n, l, m).
<input type="checkbox"/>	The energy of an electronic orbital is determined by only two quantum numbers (n, l).
<input type="checkbox"/>	Magnetic quantum number, m <sub>l</sub> , defines the shape and orientation of orbitals.
<input type="checkbox"/>	Spin quantum number describes the electron magnetic field when it rotates about its own axis.

3.- Which of the following molecules would yield more CO<sub>2</sub> when fully burning 1mol?

<input type="checkbox"/>	CH <sub>4</sub>
<input type="checkbox"/>	C <sub>2</sub> H <sub>6</sub>
<input type="checkbox"/>	C <sub>4</sub> H <sub>9</sub> Cl
<input type="checkbox"/>	CH <sub>2</sub> O

4.- The electronic configuration of a certain atom is 1s<sup>2</sup>2s<sup>2</sup>2p<sup>6</sup>3s<sup>1</sup>. Which of the following statements is false?

<input type="checkbox"/>	It tends to form anions
<input type="checkbox"/>	It is a metal
<input type="checkbox"/>	It is located at the third period in the periodic table
<input type="checkbox"/>	It is bigger than lithium

5.- 100ml of 0.2M solution of HBr are mixed with 250ml of HCl 0.1M. Assuming volumes are additive, which are the concentrations of the ions in solution?

<input type="checkbox"/>	[H <sup>+</sup> ]=[Cl <sup>-</sup> ]= [Br <sup>-</sup> ]
<input type="checkbox"/>	[H <sup>+</sup> ]>[Cl <sup>-</sup> ]> [Br <sup>-</sup> ]
<input type="checkbox"/>	[H <sup>+</sup> ]>[Br <sup>-</sup> ]> [Cl <sup>-</sup> ]
<input type="checkbox"/>	[H <sup>+</sup> ]>[Br <sup>-</sup> ]= [Cl <sup>-</sup> ]

6.- The chemical formula of potassium permanganate is:

<input type="checkbox"/>	K <sub>2</sub> MnO <sub>2</sub>
<input type="checkbox"/>	KMnO <sub>2</sub>
<input type="checkbox"/>	K <sub>2</sub> MgO <sub>3</sub>
<input type="checkbox"/>	KMnO <sub>4</sub>

7.- Consider a solution of HNO<sub>3</sub> =0.1N and a solution of HCl 0.1N. When titrating these solutions with NaOH up to neutralization, at the equivalence point:

<input type="checkbox"/>	Both solutions have the same acidic pH
<input type="checkbox"/>	The first one has higher pH
<input type="checkbox"/>	The second one has higher pH
<input type="checkbox"/>	Both solutions have the same pH

8.- Consider a nuclide of mass  $m_X$  composed of  $N$  neutrons ( $m_N$ ) and  $Z$  protons ( $m_Z$ ). Which of the following statements is correct:

<input type="checkbox"/>	$m_X = m_N + m_Z$
<input type="checkbox"/>	$m_X < m_N + m_Z$
<input type="checkbox"/>	$m_X > m_N + m_Z$
<input type="checkbox"/>	$m_X - m_N - m_Z$ is the binding energy per nucleon

9.- Which of the following statements about  $\text{NH}_3$  is true:

<input type="checkbox"/>	It is an acid
<input type="checkbox"/>	It is a base
<input type="checkbox"/>	It is a buffer
<input type="checkbox"/>	It is a solid

10.- Write in decreasing order the radius of the following atoms and ions: K,  $\text{K}^+$ , Mg, Al,  $\text{Al}^{3+}$ .

<input type="checkbox"/>	$\text{Al} > \text{Mg} > \text{K} > \text{K}^+ > \text{Al}^{3+}$
<input type="checkbox"/>	$\text{K} > \text{Mg} > \text{Al} > \text{K}^+ > \text{Al}^{3+}$
<input type="checkbox"/>	$\text{Al}^{3+} > \text{K}^+ > \text{Mg} > \text{K} > \text{Al}$
<input type="checkbox"/>	$\text{Al} > \text{K} > \text{Mg} > \text{K}^+ > \text{Al}^{3+}$

11.- Which of the following compounds has more polar bonds and which is more polar?  $\text{CH}_4$ ,  $\text{CCl}_4$ ,  $\text{CF}_4$ ,  $\text{CH}_3\text{Cl}$

<input type="checkbox"/>	$\text{CCl}_4$ : highest bond polarity and $\text{CF}_4$ : highest polarity.
<input type="checkbox"/>	$\text{CH}_3\text{Cl}$ : highest bond polarity and $\text{CCl}_4$ : highest polarity.
<input type="checkbox"/>	$\text{CF}_4$ : highest bond polarity and $\text{CH}_3\text{Cl}$ : highest polarity.
<input type="checkbox"/>	$\text{CF}_4$ : highest bond polarity and $\text{CF}_4$ : highest polarity.

12.- Write the Lewis structure of ozone ( $\text{O}_3$ )


13.-  $\text{SO}_2$  and  $\text{H}_2\text{O}$  molecules are both angular but bond angle in the former is  $119^\circ$  and  $109^\circ$  in the later. Could you explain why?

<input type="checkbox"/>	Because sulfur has larger radius than oxygen
<input type="checkbox"/>	Because of the hydrogen bonds in water molecule
<input type="checkbox"/>	Because sulfur has only one lone pair of electrons while oxygen has two
<input type="checkbox"/>	Because oxygen has only one lone pair of electrons while sulfur has two

14.- Let us call  $x$  the axis that contains the two nucleus of a diatomic molecule. Which of the following is true?

<input type="checkbox"/>	The bonding MO formed by combination of two $p_y$ has one nodal plane
<input type="checkbox"/>	The antibonding MO formed by combination of two $s$ has two nodal planes
<input type="checkbox"/>	The bonding $\pi_x$ has one nodal plane
<input type="checkbox"/>	The overlapping between two $p_x$ has cylindrical symmetry

15.- Which of the following molecules presents the highest paramagnetism?  $\text{Li}_2$ ,  $\text{B}_2$ ,  $\text{N}_2$ ,  $\text{Ne}_2^+$

<input type="checkbox"/>	$\text{Li}_2$
<input type="checkbox"/>	$\text{B}_2$
<input type="checkbox"/>	$\text{N}_2$
<input type="checkbox"/>	$\text{Ne}_2^+$